Interactive Stereoscopic Visualization of Large-Scale Astrophysical Simulations

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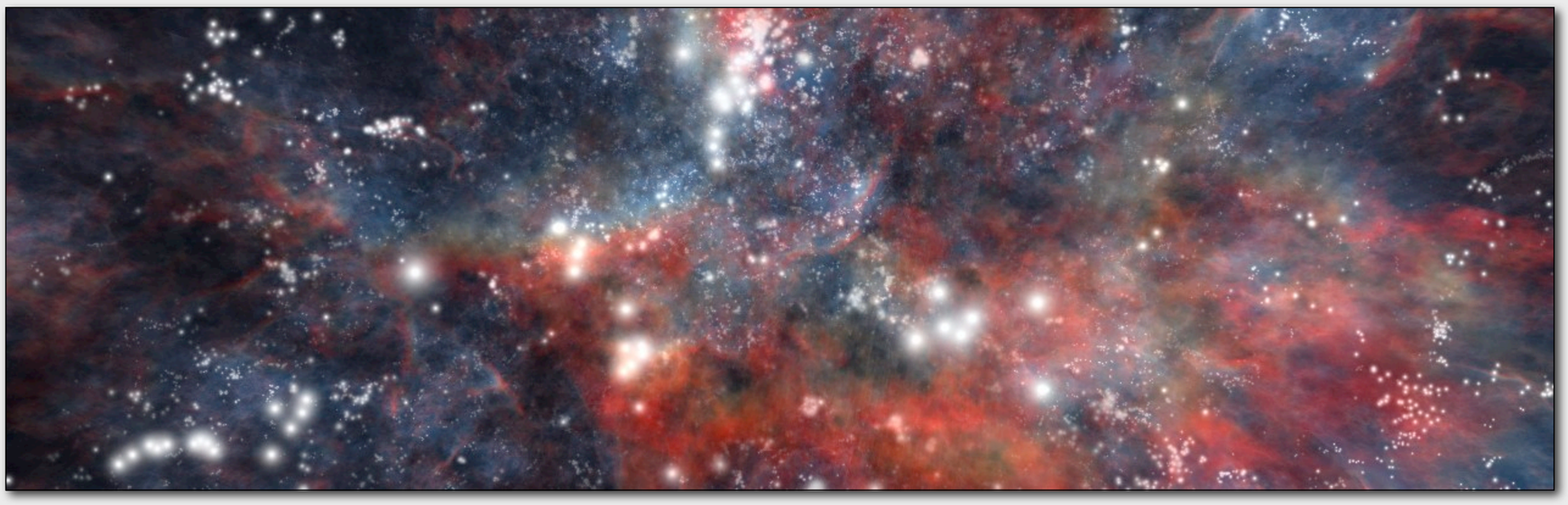
Scope

Application Domain

- Interactive 3D visualization
- N-body & SPH simulations
- (Magneto-)hydrodynamic simulations

Data Types

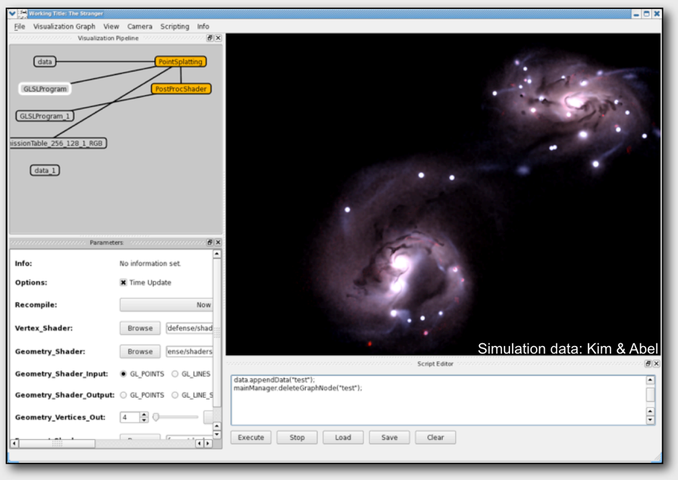
- Unstructured point sets
- Regular & AMR grids
- Scalar and vector valued data



Software

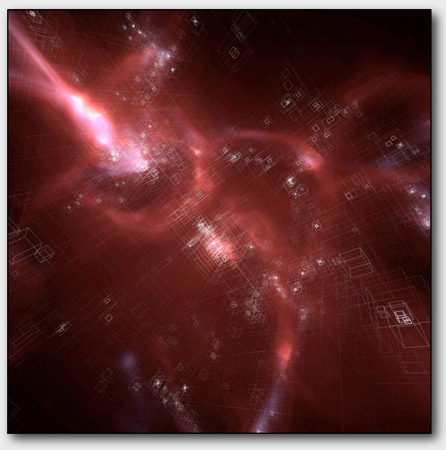
Architecture

- C++
- Library & Qt-based GUI
- Full GPU support
- OpenGL, GLSL



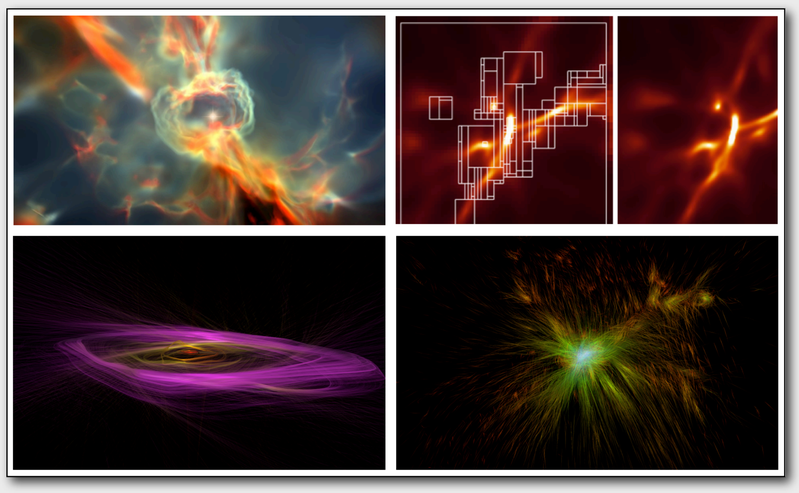
Features

- Stereoscopic rendering
- Full-dome rendering mode
- Readers for various formats
- Scripting interface
- 32-bit floating-point pipeline
- Camera path editing

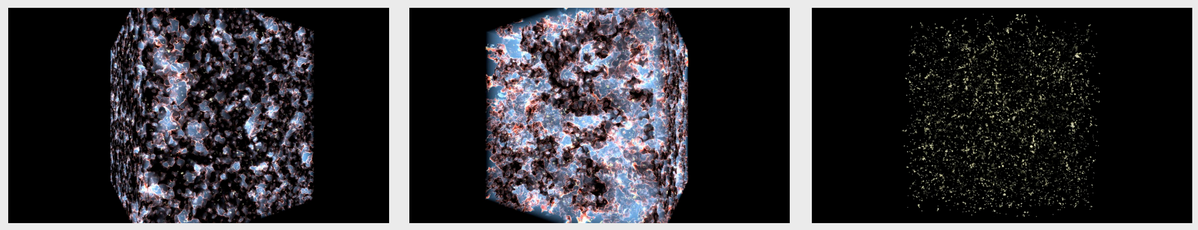


Visualization Methods

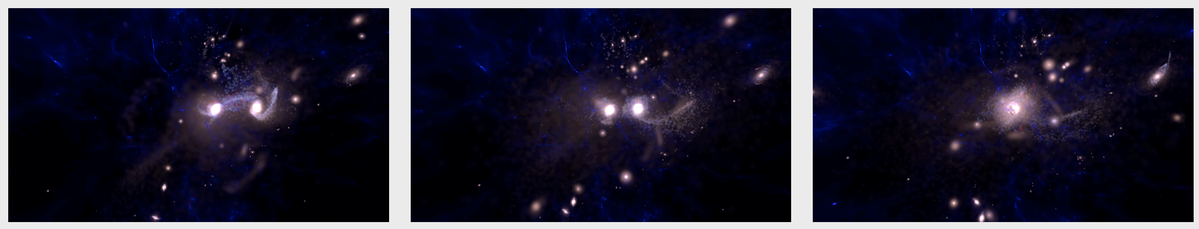
- Direct Volume Rendering
- Slicing
- Streamlines
- Pathlines
- Point splatting



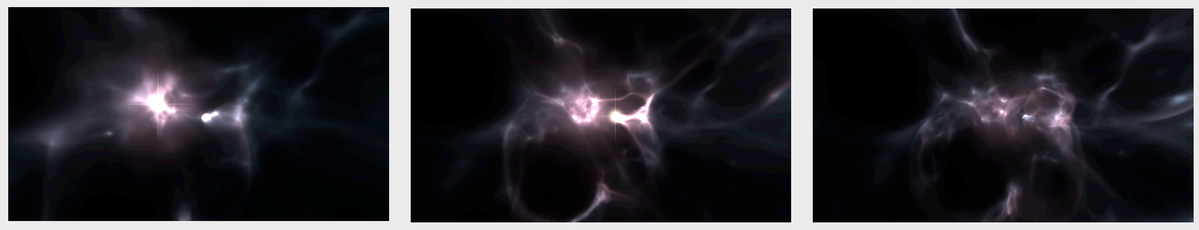
Projects



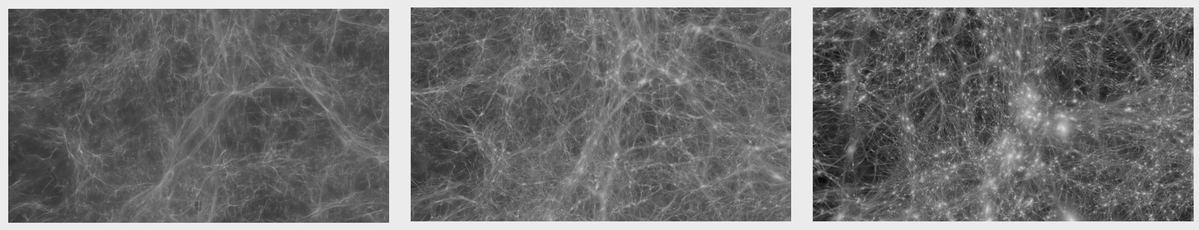
Reionization era in the early Universe.
Numerical simulation by Marcelo Alvarez (CITA) and Tom Abel.



Formation of large-scale structures and massive galaxies in the early Universe. Preview for planetarium show "*The Big Bang*", narrated by Liam Nesson, AMNH 2010.
Numerical simulation by Ji-hoon Kim (UCSC) and Tom Abel.



Formation of the first stars in the Universe and their feedback on their gaseous environment.
Preview for planetarium show "*Life: A Cosmic Story*", narrated by Jodie Foster, CalAcademy 2010.
Numerical simulation by John Wise (Georgia Tech) and Tom Abel.



Large-scale structure formation in the Universe.
Numerical Simulation by Oliver Hahn (Stanford) and Tom Abel

Future Work

- Support of GPU-clusters
- Subroutines in CUDA & OpenCL
- Visualization of data on tetrahedral grids
- Efficient remote rendering
- Support of tiled-display walls

References

- R. Kähler, T. Abel, "Interactive Stereoscopic Visualization of Large-Scale Astrophysical Simulations", to appear in Proceedings of IS&T/SPIE Electronic Imaging Symposium 2012
- R. Kähler, M. Alvarez, T. Abel. "Visualizing the Reionization of the Universe on Programmable Graphics Hardware", Astronom 2010
- R. Kähler, T. Abel, H.-C. Hege. "Simultaneous GPU-assisted Raycasting of Unstructured Point Sets and Volumetric Data", Proceedings of IEEE/EG International Symposium on Volume Graphics 2007
- R. Kähler, J. Wise, T. Abel, H.-C. Hege. "GPU-Assisted Raycasting for Cosmological Adaptive Mesh Refinement Simulations", Proceedings of Volume Graphics 2006